Model AL-350200
Conductivity Detector

Service Manual

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SSI
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Model AL-350200 Conductivity Detector Service Manual

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1. INTRODUCTION

About the Conductivity Detector

The Conductivity Detector can be interfaced with any HPLC or IC pumping system to provide high-sensitivity detection of charged substances. The Conductivity Detector utilizes a high-frequency (3 KHz) sinusoidal applied potential and synchronous detector to measure minute changes in conductance of the column effluent. A one-touch background suppression circuit provides electronic compensation for the conductivity of the eluant bringing the baseline to electrical zero. Advanced microprocessor based circuit design reduces extraneous electrical noise allowing stable operations at very high sensitivity ranges. Ten ranges from 0.1 to 5000µS/cm makes the Conductivity Detector compatible with all current IC methods, including ultra-trace level applications. The Conductivity Detector utilizes a temperature controlled cell housing for enhanced baseline stability. The heater maintains the cell at a preset temperature and preheats column effluent to minimize thermally induced noise and drift. The Conductivity Detector is equipped with a RS-232 serial communication port for remote operation of the detector functions.

The Conductivity Detector includes:

- a temperature controlled cell housing to maintain baseline stability regardless of variations in ambient temperature.

- a high-sensitivity, microprocessor based electrical conductivity detector with low dead-volume flow cell, and electronic background correction.

Specifications:

Electrical/Electronic
Power: 110/220V AC, 50/60 Hz, 100 Watts (field-selectable).
Data: Analog Output: 0-1 V DC or 0-10 mV DC (selectable).
Computer Interface: RS-232 serial communication.

Fluid Path
Construction: All wetted parts are of inert polymers (PEEK [polyetherether ketone] and TFE)

Cell Compartment
Insulation: Minimum 1" all sides
Temperature Control:
Type: 50W DC heating element vulcanized to aluminum block
Oven Size: 2.7" W x 2.45" H x 6.2" L (Nominal)
Temperature: Factory set at 35° C, user adjustable
Overtemperature Protection: Factory set at 60° C, user adjustable
Precision: ±0.05° C
Heat Exchanger: Non-metal TFE tubing knitted and encased in high thermal mass housing

Detector
Type: Alternating current, Synchronous Detection 3 KHz Frequency
Range: 10 switchable: 0.1, 0.5, 1, 5, 10, 50, 100, 500, 1000, 5000 µS/cm
Noise: Less than 0.0025 µS/cm
Drift: Less than 0.03 µS/cm/hour
Autozero: Offsets background signal up to 10,000 µS/cm
Cell Type: 2 electrode, gold plated, 0.5 µL volume mounted vertically
Display: 4 Digit LED Display in Six Modes: **Working Modes:** **a. Calibrate:** Test Reading of 100 µS/cm, with 10-step gain test **b. Background:** Absolute conductivity of eluant **c. Measure:** Conductivity with background offset **Display Modes:** **a. Conductivity:** Conductivity in µS/cm **b. Temperature:** Actual cell temperature in ° C **c. Temperature Set:** Cell temperature set-point in ° C
Time Constant: Fast or Slow (selectable)
Output: 10 mV or 1 V FS (switch selectable)

Principle of Operation

The Conductivity Detector measures the AC conductance of a liquid sample across two gold-plated electrodes, which are separated by an insulator. A 3 KHz oscillator is used to eliminate any polarization of electrodes. The detector ranges from 0.1 to 5000 µS/cm and is recorded by an external recorder or data system through an analog signal output. The Conductivity Detector has a new microprocessor circuit that improves detection sensitivity by reducing baseline noise and drift.

The Conductivity Detector has 6 settings in two separate modes of operation - **Working Mode** and **Display Mode**. The **Working Mode** includes CALIBRATE, BACKGROUND, and MEASURE. The CALIBRATE mode is used to calibrate the electronic and verifies its stability. See page 11 for details. The BACKGROUND mode is used to measure the absolute conductivity of the eluant or any solution that flows through the detector cell. In this mode of operation, the autozero is disabled; therefore the current signal is the actual conductance of the solution in the cell. In this mode, the Conductivity Detector can be used as a conductivity meter. See page 11 for details. The MEASURE mode is used to measure conductivity with baseline subtracted. The current resulting from the eluant conductivity (no sample present) is subtracted by the autozero circuitry. The Display Mode includes CONDUCTIVITY, TEMPERATURE, and TEMPERATURE SET. The LED on the Conductivity Detector can be used to display any of these modes. In CONDUCTIVITY mode, the LED displays the conductance of a solution in µS/cm % full scale range. In the TEMPERATURE mode, the LED displays the actual temperature of the cell compartment in ° C. In the TEMPERATURE SET mode, the LED displays the cell temperature set point. This mode can be accessed by pressing the TEMP/TEMP SET key twice until the display blinks. See page 9 for details.

The Conductivity Detector uses a microprocessor to control the autozero process. During the autozero process, the conductance detected by the cell is sampled, processed and memorized. During normal operation, the memorized data is converted to analog signals to substract the baseline of the eluant. A special algorithm is used for fast and accurate baseline subtraction. Depending on the magnitude, noise, and drift of the eluant conductance, the autozero process will be completed in 2-3 seconds. The microprocessor is also used to simplify the keypad operations of the detector. Most functions can be completed by pressing only one key. For example, no matter what the mode the Conductivity Detector is in, when the autozero key is depressed, the microprocessor will automatically set its mode in MEASURE and resume the latest range setting and start the autozero process. The microprocessor monitors the RS-232 port. All keypad functions are accessible through the RS-232 port.

2. INSTALLATION

What You Will Need

In addition to the Conductivity Detector itself, you will need the following for installation of a complete chromatographic system:

Components:

- An HPLC pump capable of low-pulsation solvent delivery at flow rates ranging from 0.5 to 4.0 mL/min against pressures up to 3,000 psig. For best results with minimal metal contamination, we recommend the Series III Bioclean HPLC pump.

- A strip chart recorder or data system capable of accepting analog voltage data. Either 0-10 mV or 0-1 V systems can be used.

- For low level anion analysis, you may require a suppressor device to suppress the eluant conductivity. We recommend the Model 335 Solid Phase Chemical Suppressor.

- An injection valve or autosampler.

- A column capable of separating the components of interest. If you are uncertain as to which type of column to use, contact your distributor for assistance. To ensure minimum metal contamination, we recommend metal-free columns.

- A guard cartridge or column compatible with the separation column used. Guard cartridges are not required for operation, but we strongly recommend their use to prolong separation column lifetime.

Tools:

- An open-end wrench accommodating 5/16 and 1/4-inch fittings.

Other:

- Solvent reservoirs, inlet filters, chart paper, pens, etc. required for pump and data recorder operation. Consult the appropriate instruction manuals for requirements.

Unpacking

The Conductivity Detector, along with the power cord and standard accessories, are shipped in the same box. Before attempting to operate the detector, unpack it carefully. Do not discard any packing material until you have carefully checked the detector and the accessories kit. A complete list of the accessories for the Conductivity Detector is given in Appendix A. If you find any evidence of damage to the unit or to the box, contact the shipping company that delivered the unit to file a claim.

Controls

Front Panel Exterior: (Figure 2.1)

1. **Digital Display:** Displays conductivity, cell temperature, or temperature set-point (when the display blinks).
2. **Conductivity:** Reads conductivity in µS/cm % full scale.
3. **Measure:** Reads changes in cell conductance with background correction.
4. **Background:** Reads absolute cell conductance with no background correction.
5. **Calibrate:** Calibrates electronic circuitry and verifies its stability. See page 11 for details.
6. **Recorder Output Time Constant:** Fast (0.2 sec) or Slow (1 sec).
7. **Recorder Output Polarity:** "+" or "-".
8. **Temperature Set:** Reads the actual cell temperature in ° C, or when depressed twice until the display blinks, shows the cell temperature set-point in ° C.
9. **Autozero Control:** Digitally offsets the background conductance while in the MEASURE mode.
10. **Range Selection Display:** Displays selected range.
11. **UP and DOWN:** Changes the operating range while in the CONDUCTIVITY mode, or the cell temperature set point while in the TEMPERATURE SET mode.
12. **Heater Indicator:** Lit when power is applied to heater. When system is at thermal equilibrium, indicator will flash briefly.
13. **Heater Overtemperature:** Lit when cell temperature exceeds the overtemperature set point.
14. **Detector Inlet Line:** A bulkhead union accepts 1/16" OD tubing for connection to column outlet.
15. **Detector Outlet Line:** A bulkhead union accepts 1/16" OD tubing for connection to additional detectors or waste bottles.

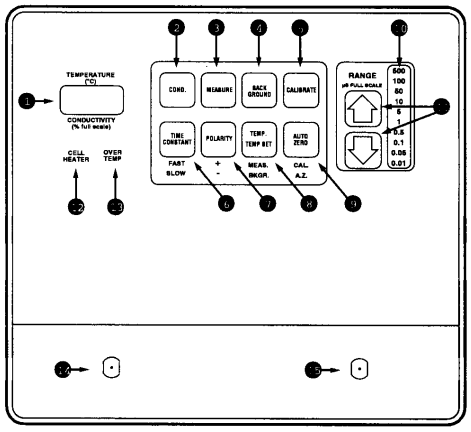


Figure 2.1: Front Panel Exterior

Back Panel, Exterior (Figure 2.2)

1. **Power:** Switches AC power to detector ON/OFF.
2. **Electrical Power Line:** 115/220V AC, 50/60 Hz, 100 Watts, field selectable.
3. **Signal Output Range Select Switch:** Selects 0-1 V or 0-10 mV full scale detector output.
4. **Signal Output Connection:** Connects Conductivity Detector to recorder or data system.
5. **RS 232 PORT:** Remote operation of detector functions.
6. **Integrator Offset Knob:** Used to adjust the signal output after the autozero is activated. (Some integrators cannot accept negative offsets).

   NOTE: This knob will also offset the value adjusted during the conductivity measurement and electronic calibration check. See page 11 for details.

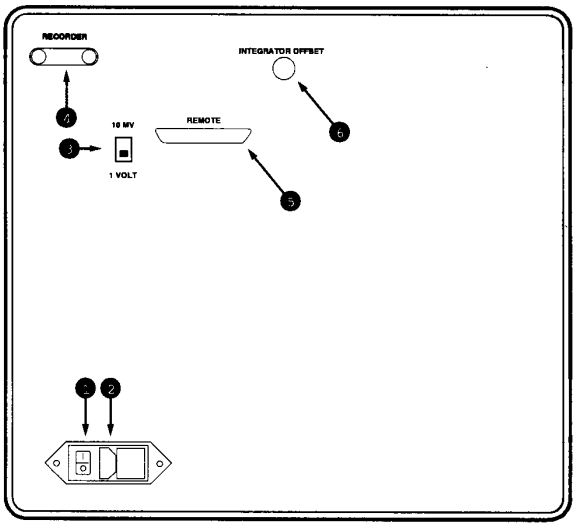


Figure 2.2: Back Panel, Exterior

Interior (Figure 2.3)

1. **Conductivity Cell/Cell Heater:** The cell compartment is located behind the removable plate which contains 2" of insulation. Access is obtained by pulling the plate forward after the chrome plated screws have been released. The cell compartment contains a knitted TFE tubing heat exchanger.

2. **Detector Electronics PC Board.**

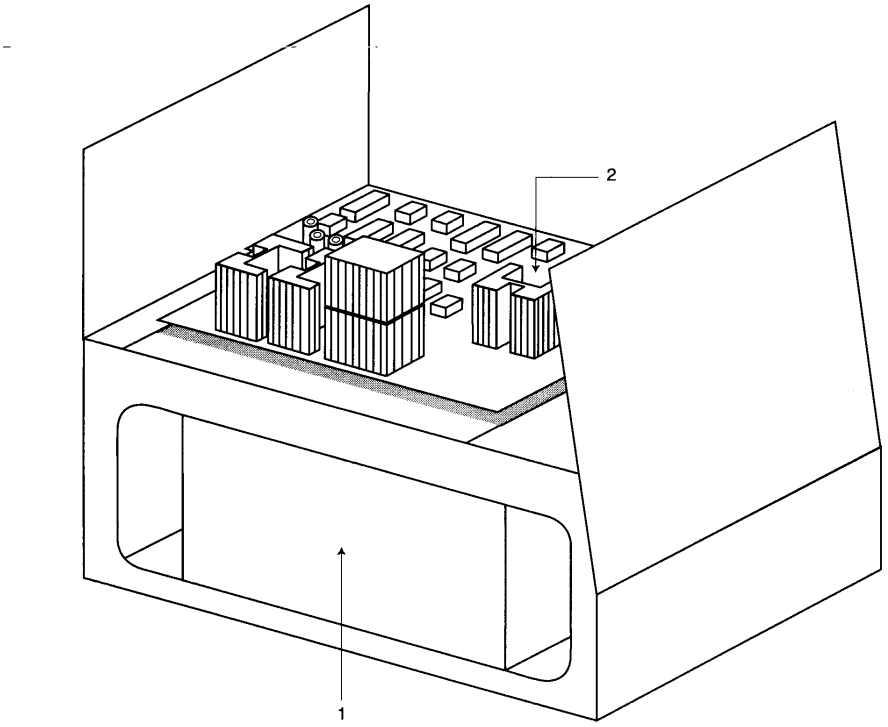


Figure 2.3: Interior

Fluid Connections

Using the metal-free compression screw (nut and ferrule) provided with the Conductivity Detector, connect a length of 1/16" OD x .010" or .007" ID tubing between the column outlet and the detector Inlet Bulkhead Union. Minimize the ID and the length of tubing between the column to the detector to avoid peak broadening. Use a 1/4-inch open-end wrench to tighten the compression screw (nut and ferrule) slightly past finger-tight. Do not overtighten!

Using the metal-free compression screw (nut and ferrule) provided with the Conductivity Detector, connect a length of 1/16" OD tubing to the detector Outlet Bulkhead Union. The open end of the tubing may be used to direct detector effluent to waste or an auxiliary detector.

Electrical Connections

Recorder/Data System Connection

Connect the signal output from the Conductivity Detector back panel to the signal input from your recorder or data system. Because the Conductivity Detector is capable of driving to greater than nominal full scale voltages, we recommend that the Conductivity Detector output range be set to 0-10 mV in most applications. Follow the data system instructions to configure the system for 0-10 mV full scale signal input. If your recorder or data system will not operate at the 0-10 mV setting, set the output range switch to 0-1 V full scale.

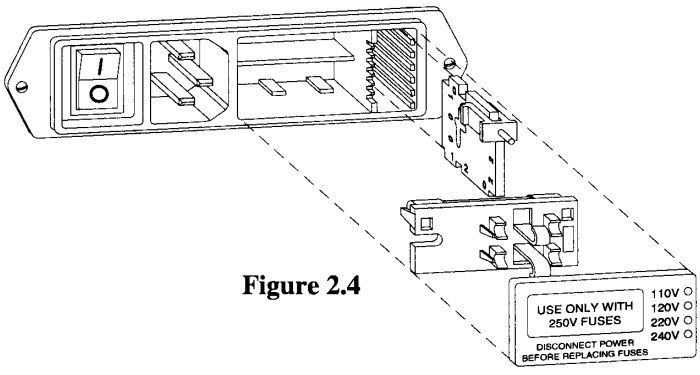


Figure 2.4

Power Connection

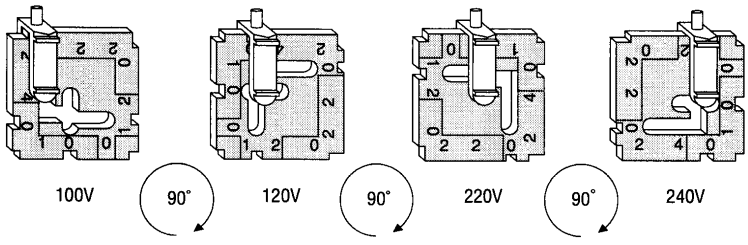
Plug the modular power cord provided with the accessory kit into the power connector on the rear panel of the detector. The voltage is field selectable for operation at 100V, 110V (U.S. standard) or 220V or 240V (European Standard).

Caution: Operation at the wrong input voltage may damage the detector.

Voltage Selection

Unplug the power cord from the power source. Insert the blade of a small screwdriver into the slot next to the power connector and gently pry open the fuse block. Pull the fuse block straight out. Use tweezers or a pair of needle-nose pliers to pull the voltage selector card straight out (Figure 2.4).

Position the plastic voltage selector for the appropriate voltage as indicated in Figure 2.5. Press the voltage selector back into place.



Fuse Replacement

Two types of fuses are provided with the Accessory Kit. When changing the fuse, be careful to use the appropriate voltage fuse. One 1.5 Amp slo-blo fuse is required for 120V operation. Two 1.0 Amp slo-blo fuses are required for 240V operation.

Equilibration

Switch on the Conductivity Detector. Allow the components to warm up until the operating temperature is reached. The cell temperature has been preset at 35° C. The cell temperature can be monitored from the digital display on the front of the detector. To monitor the cell temperature depress the TEMPERATURE key. Initially, the cell heater light will glow continuously indicating the cell has not yet reached operating temperature. When operating temperature is reached, the heater lamp will dim slightly.

Initial Adjustment

1. Set the following by depressing the corresponding membrane keys on the Conductivity Detector:

   Conductivity: Conductivity
   Time Constant: Slow
   Polarity: "+" for Anions "-" for Cations
   Background: Background Position
   Range: 100µS/cm

2. With recorder or data collection system ON, note noise and slope of baseline for a 5-10 minute period.

3. When the baseline is stable (i.e., no drift), depress the MEASURE key.

4. Set RANGE to desired operating range. Range 10 is suitable for most applications.

5. Depress AUTOZERO (Background Eluant conductivity is now subtracted). This procedure can be repeated as often as necessary.

   NOTE: Because the Conductivity Detector's autozero circuit resets the zero to within +/- 2% of true zero, it is possible to have a baseline at a slightly negative potential.

6. Some integrators can not conveniently handle negative offset. In this case, the integrator offset knob located on the back of the detector can be used to bring the signal output up to a positive value.

Remote Operation

RS-232 Serial Communication Port

The RS-232 port provides remote operation of the detector functions or digital transmission of the detector signal. The RS-232 port is a 25-pin socket located on the back side of the detector. The RS-232 port on your computer will have the 25-pin or a 9-pin configuration. Your computer may have other ports, such as game, printer, and application ports, which may have the same configuration. Make sure you find the correct RS-232 type port. On the IBM PC, the RS-232 port is identified by either COM1 or COM2.

Make the connection between the computer port and the detector port using either the RS-232 cable with 25-pin on both ends or the RS-232 cable with 25-pin and 9-pin. Make sure you turn the computer and the detector off before making this connection. After making this connection, you can control the detector functions through your data system with a suitable program.

Customized Programming

Experience in a programming language such as C or Basic is a prerequisite to writing a customized program for the RS-232 port.

PROGRAMMING PARAMETERS:

BAUD RATE:	2400 (others available upon request).
WORD FORMAT:	one start bit (0), eight data bits (x), and a stop bit (1).
PARITY:	NONE.

PIN SET-UP:

2:	RxD - receive data from the computer.
3:	TxD - transmit data to the computer.
7:	GND- ground.
11:	Remote autozero.
12, 13, 24, 25:	Reserved remote control by TTL logic signal.

Remote Autozero

The Autozero function may be triggered from a non-RS-232 device using either a contact closure or TTL signal and the remote autozero cable included in the accessory kit. Connect the remote autozero cable to the RS-232 port on the back of the detector. Attach the two leads on the other end of the cable to the appropriate connectors on the remote device. Both contact closure and TTL signals will initiate the autozero function, as described below:

Contact Closure: The autozero function is initiated when a contact closure occurs.

TTL: The autozero function is initiated when the TTL signal goes from 'high' to 'low'. An open collector device should be used, or the front panel autozero key may not function.

CAUTION: Do not apply signals outside the normal TTL range or detector damage may occur!

3. ROUTINE OPERATION

Warm-up Time

Normally, the detector electronics should be left ON at all times. If this has been done, the system should be allowed to equilibrate for approximately 30 minutes with eluant flowing. This will allow complete equilibration of the column with the eluant.

If the system has been switched OFF, the system should be allowed to warm-up to thermal stability. This normally takes between 20 to 30 minutes (depending on your room temperature), at the preset temperature of 35° C. It may take longer if the operating temperature has been changed to a higher level or if the starting temperature of the Conductivity Detector is significantly below normal room temperature. To monitor the cell temperature depress the TEMP/TEMP SET key and read the value on the Digital Display. Once operating temperature is reached, the cell heater light on the front panel of the detector will dim slightly.

Initial Settings

After the system has equilibrated, check for desired operating range and reset autozero corrections as follows:

1. Set the RANGE to the desired value (Range 10 is suitable for most IC applications).

2. Set the operating mode to MEASURE.

3. Activate AUTOZERO (When autozero light goes out, unit is ready).

The AUTOZERO function rapidly offsets the eluant background conductivity. Depress the AUTOZERO switch before each injection to insure baseline correction.

Changing Temperature Set Point

The Conductivity Detector utilizes a temperature controlled cell housing for enhanced baseline stability. The temperature set point has been set at 35° C during manufacturing. The temperature controlled cell can be adjusted to within ± 0.1° C of any temperature between ambient temperature and 80° C. The current cell temperature can be read directly from the digital display on the front of the detector by selecting temperature with the TEMP/TEMP SET key once.

To change the temperature set point depress the TEMP/TEMP SET key twice. The temperature reading will flash. Increase or decrease the temperature set point by depressing the UP or DOWN arrows on the RANGE key.

NOTE: The overtemperature control circuit on the Conductivity Detector is preset at the factory to 60° C. If the operating temperature is to be reset above 60° C, first reset the overtemperature set point (see the following section).

Changing Overtemperature Set Point

When a change has been made to the cell heater temperature set point, the overtemperature set point may need to be adjusted. The overtemperature has been set at 60° C. Adjust the overtemperature set point to approximately 20° C higher than the heater temperature set point.

The overtemperature control circuit provides an external means of protecting your equipment. When the cell temperature reaches the overtemperature set point, the overtemperature light will turn on and the heater will be turned off. The overtemperature set point can be set by adjusting POT P1.

To adjust the overtemperature set point:

1. Remove the cover of the detector and locate the POT P1 and the test point TP1. They are located at the corner of the PC board (Figure 3.1).

2. Use a DC voltage meter to measure the voltage at TP1. 10 mV corresponds to 1° C. If you want to set

the overtemperature set point to 60° C, the voltage at TP1 should be 600 mV. Adjust POT P1 to get the correct voltage. Turning P1 clockwise will decrease the overtemperature set point. Likewise, turning P1 counterclockwise will increase the overtemperature set point.

3. If you do not have a DC voltage meter you can still adjust the overtemperature set point. Set the cell temperature set point so that it is higher than the desired overtemperature set point (Example: If you want to set the overtemperature set point at 60° C, then set the cell temperature set point > 60° C). Wait for the cell temperature to reach the expected overtemperature set point. Then adjust P1 until the overtemperature light turns on. You can hear a relay click which turns off the heater. You can adjust P1 back and forth to get the overtemperature light to turn on just at the point you want.

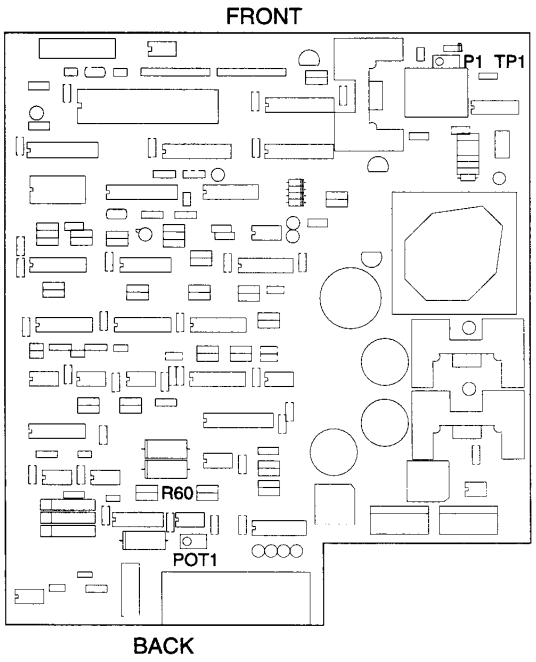


Figure 3.1

4. MAINTENANCE & TROUBLESHOOTING

Routine Maintenance

Because of its simple, rugged design, the Conductivity Detector does not require maintenance or service on a routine basis. This section deals with the solutions to a few problems which may arise in routine operation.

1. Even a very small leak can cause baseline noise. Approximately once a month inspect the interior of the cell compartment for signs of leakage.

2. A noisy baseline characterized by rapid noise "spikes" is most often the result of air bubbles in the cell (as shown in Figure 4.2). This situation typically occurs on initial operation of a new column or an unused column which has been allowed to dry out. The only remedy is time (20 - 45 minutes) for the trapped air bubbles to be purged from the cell. If the problem persists for more than 45 minutes, boil approximately 250 mL of deionized water and remove the columns from your system. Pass/circulate the boiled water through the cell for a few hours. Persistent problems with air bubbles may be caused by failure to degas eluants properly. Most eluants can be degassed by filtering through a 0.2 micron membrane filter under vacuum, by sonication in an ultrasonic bath, or by helium sparging. Bubble formation in the cell can be minimized by attaching a restrictor (approx. 1m of 1/16" OD x 0.01" ID tubing) to the detector bulkhead union outlet. Conductivity Detector cells are leak-tested to 500 psig. Irregular noise may be due to contamination of the cell with organic material leached from a column or precipitated from a sample. Flushing the cell with isopropyl alcohol or similar polar organic solvent often solves baseline noise problems stemming from this cause.

3. Irregular noise that does not respond to cell cleaning as described above may be due to flow irregularities in the pumping system or to impurities leaching from the column. To check this possibility, shut the pumping system OFF and allow 5 minutes or so for the baseline to stabilize at a new level. If the "no flow" baseline is noise-free, assume the problem stems from the column, from the eluant, or from the pump rather than from the Conductivity Detector. To check if the problem is due to the column, remove the column (including guard column) and pump the eluant directly through the cell (Pump pulsation may appear). If the noise stops, the problem must be from the column. Clean or replace the column.

4. Use the following procedure to differentiate electronic problems from flow-related problems.

    a. Turn the integrator offset knob all the way counterclockwise (facing the back of the detector). Press the CALIBRATE key, the range should automatically go to 100 µS/cm. As this is accomplished, the numbers 000 through 999 are sequentially displayed, verifying display function and detector gain settings. The final display value should read between 99.5 and 100.5. See "Electronic Calibration Check" for details.

    b. Place detector in MEASURE position and RANGE in 5000 µS/cm. The unit should have a conductivity reading. The number is not important, but the reading should be "On Scale."

    c. Change RANGE to a lower value and observe if conductivity reading increases.

    d. Activate AUTOZERO. Reading should go to zero.

5. Each time the Conductivity Detector turns on, the microprocessor conducts a self-calibration procedure. If the self calibration procedure fails, the detector may behave erratically (i.e., temperature control does not respond, etc.). Should this occur, depressing the AUTOZERO or the CALIBRATE key will remedy the problem.

    NOTE: If the instrument fails to respond to the above tests, you should assume that the problem is an electronic failure within the detector. Contact your distributor for assistance.

Measuring Absolute Conductivity

The Conductivity Detector's primary function is detecting ionic species in chromatography applications. However, it can be used as a conductivity meter to measure the absolute conductance of a solution using the following procedure:

1. Place the detector into BACKGROUND mode by depressing the BACKGROUND key.

2. Set the polarity to "+" and the time constant to "fast."

3. Set the Range to match the expected conductance value of your unknown. If you are not sure, pass the unknown conductance solution through the detector and move the Range up or down until the conductivity reading is "on scale."

4. Pass distilled deionized water through the detector cell. The water must have a resistant of 18 megaohm or higher. Use the integrator offset knob located at the back of the Conductivity Detector to zero the digital display (do not use the AUTOZERO key). Failure to properly zero the display will lead to erroneous readings.

5. Pass the unknown conductance solution through the detector. Move the Range up or down until the conductivity reading is "on scale." The display reads conductivity in µS/cm % full scale range.

6. The detector is factory-calibrated with known conductance standards. The detector may be recalibrated using the procedure in Appendix C.

    Note: The conductivity measurement will change, leading to erroneous results, if the integrator offset knob is changed from the position set in step 4.

Electronic Calibration Check

The Conductivity Detector electronics are calibrated before shipping. Verify calibration stability using the following procedure:

1. Set the polarity to "+" and the time constant to "fast."

2. Turn the integrator offset knob located at the back of the Conductivity Detector all the way counter clockwise (facing the back of the detector).

3. Depress the CALIBRATE key. The range will switch automatically to 100 µS/cm. As this is accomplished, the numbers "000" through "999" are sequentially displayed, verifying display function and detector gain settings. The circuit then measures and displays conductivity through a fixed internal resistance. The final display value should read between 99.5 and 100.5. If the displayed value is outside this range, the detector electronics should be recalibrated using the procedure in Appendix D. Alternately, the detector may be returned to your distributor for recalibration.

    NOTE: The calibrate value will change if the integrator offset knob is moved from the fully counterclockwise position set in step 2. This is normal and does not indicate detector malfunction.

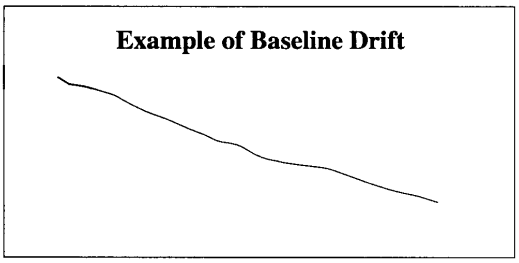


Figure 4.1

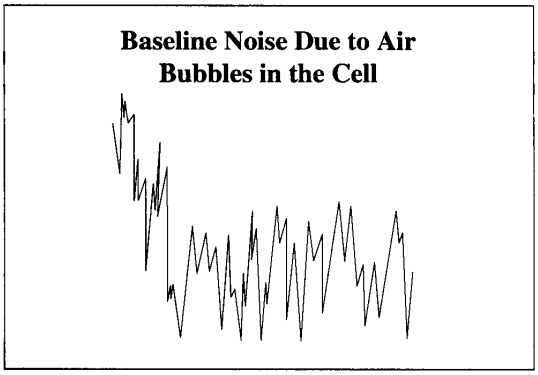


Figure 4.2

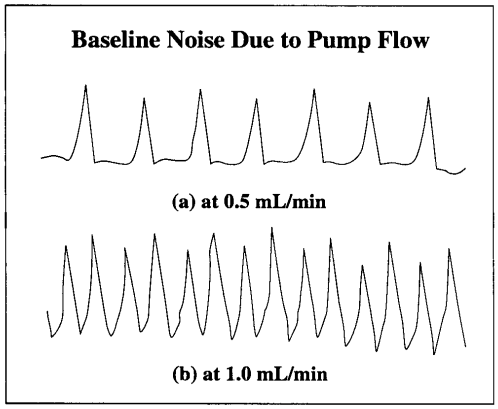


Figure 4.3

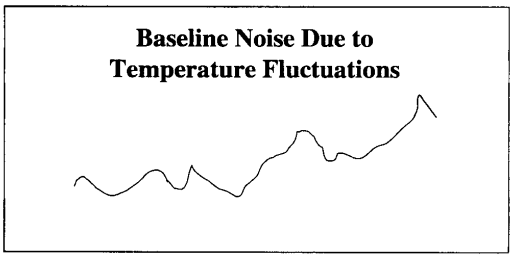


Figure 4.4

Troubleshooting Charts:

The following charts summarize possible problems that can be encountered during operation of the Conductivity Detector, the causes of those problems, and the most effective remedies.

Chromatographic Problems		
Symptom	**Cause**	**Remedy**
Baseline Drifts (as shown in Figure 4.1)	**1.** Temperature (as shown in Figure 4.4)	Allow system to equilibrate; if room temperature is close to 30° C, try operating at higher temperature
	2. New eluant	Allow system to equilibrate
	3. Dead volume	Purge gauges, tees, valves, etc.
	4. Column contamination	Regenerate column (follow manufacturer's procedure)
Noise Baseline	**1.** Trapped air bubbles (shown in **Figure 4.2**)	See step 2 under MAINTENANCE section
	2. Pump flow (shown in **Figure 4.3**)	Shut off pump. If baseline is quiet, then service pump per manufacturer's recommendation
	3. Cell contamination	Shut off pump. If noise persists, clean or replace cell.
	4. Column	Regenerate or change column
	5. Eluant	Degas eluant
	6. Temperature (as shown in **Figure 4.4**)	Insulate column
Peak Shape	**1.** Overload	Reduce sample size
	2. Column	Regenerate column
	3. Guard	Replace guard
	4. Dead volume	Check column/guard connections
Retention Time	**1.** Pump	Service pump per manufacturer's recommendation
	2. Eluant	New eluant

Detector Problems		
Symptom	**Cause**	**Remedy**
Unable to Zero	**1.** Offset by offset knob	Adjust offset knob
	2. Eluant conductivity too high	New eluant
	3. Electronic failure	Contact distributor
No Power	**1.** Line unplugged	Plug in power line
	2. Blown fuse	Replace fuse
	3. Electronic failure	Contact distributor

Cell Temperature Control Problems		
Symptom	**Cause**	**Remedy**
No Power	**1.** Line unplugged	Plug in power line
	2. Blown fuse	Replace fuse
	3. Electronic failure	Contact distributor
Not Heating	**1.** Line unplugged	Plug in power line
	2. Cooling down to lower temp	Wait
	3. Electronic failure	Contact distributor
Full Heat	**1.** Warming up to higher temp	Wait
	2. Electronic failure	Contact distributor
Controlled Temp does not Match Temp Set Point	**1.** Failed power-up self-calibration	Press calibrate key to recalibrate detector

Physical Problems		
Symptom	**Cause**	**Remedy**
Leak at Bulkhead Union	**1.** Loose fittings	Tighten fittings
	2. Old ferrule	Replace ferrule
	3. Wrong ferrule	Replace ferrule
	4. Damaged bulkhead union	Replace bulkhead union

Physical Problems		
Symptom	**Cause**	**Remedy**
Overtemp Lamp Lit	**1.** Cell temperature above overtemp set point	Wait
	2.Overtemperature set point below cell temperature set point	Reset over-temperature set point
	3. Fluid leak	Tighten fitting
	4. Electronic failure	Contact distributor

3. APPENDICES

Appendix A

Standard accessories for Conductivity Detector

The following are included in the accessory kit:

- 1.5 Amp Slo-Blo Fuse (120V)
- 1.0 Amp Slo-Blo Fuse (240V)
- Power cord (115 Vac)
- PEEK nuts, pkg/5
- 1/16" x 0.007" ID PEEK tubing, 800 psig (10 ft.)
- PEEK double ferrules, pkg/5
- Remote autozero cable

Appendix B

Replacement & spare parts for Conductivity Detector

Part No.	Description
Tubing	
011278	Tubing, 1/16" OD x .010" ID, PEEK Bioclean (5 ft.)
Fittings	
060149	E-Z Grip nut, 1/16", 10-32 CPI seat, PEEK Bioclean, pkg/10
060108	E-Z Grip ferrule, 1/16", PEEK Bioclean, Pkg/10
060100	PEEK 1/16" Coupling
060146	PEEK 1/16" Bulkhead Union Assembly
Miscellaneous	
AL-320103	Heat Exchanger Assembly
AL-320204	Cell Assembly
AL-23010701	Recorder Cable
AL-350400	RS-232 Cable with 25-pin on both ends
AL-350401	RS-232 Cable with 25-pin and 9-pin
AL-350402	Remote Autozero Cable

Appendix C

Conductivity Calibration Procedure for the Conductivity Detector

The Conductivity Detector's primary function is detecting ionic species in chromatography applications. However, it can be used as a conductivity meter to measure the absolute conductance of a unknown solution. The detector is factory calibrated to read absolute conductance, but may be recalibrated using the following procedure:

1. Remove the detector cover by unscrewing the four screws on the sides of the detector.

2. Locate gain potentiometer POT 1 on the PC board (Figure 3.1).

3. Set the polarity to "+" and the time constant to "fast."

4. Place the detector into BACKGROUND mode by depressing the BACKGROUND key.

5. Set the Range to match the expected conductance value of your standard.

6. Pass distilled deionized water through the detector cell. The water must have a resistant of 18 megaohms or higher.

7. Use the integrator offset knob located at the back of the detector to zero the digital display (do not use the AUTOZERO key).

8. Pass a known conductance solution through the detector. The display reads conductivity in µS/cm % full scale range. If the conductivity reading is different from the actual conductance of your standard solution, adjust the gain potentiometer POT 1 with a small screw driver until the correct reading is displayed.

9. Repeat step 6. The reading should return to zero. Otherwise, repeat step 6 through 8 until stable, consistent readings are obtained.

10. Verify detector electronics calibration using the "Electronic Calibration Check" procedure described in this manual. If the value is outside the established range, recalibrate the electronics using the procedure in Appendix D.

NOTE: The conductivity measurement will change if the integrator offset knob is changed from the position set in step 7, leading to erroneous results.

Appendix D

Electronic Calibration Procedure for the Conductivity Detector

Detector electronics are factory-calibrated before shipping. You can check the electronic and verify its stability using the "Electronic Calibration Check" procedure described in this manual. Should the calibrate value fall outside the acceptable range, you may recalibrate the detector using the following procedure:

1. Remove the detector cover by unscrewing the four screws on the sides of the detector.

2. Locate potentiometer POT R60 on the PC board (Figure 3.1).

3. Set the polarity to "+" and the time constant to "fast."

4. Turn the integrator offset knob located at the back of the Conductivity Detector all the way counter clockwise (facing the back of the detector).

5. Depress the CALIBRATE key. The range will switch automatically to 100 µS/cm. As this is accomplished, the numbers "000" through "999" are sequentially displayed, verifying display function and detector gain settings. The circuit then measures and displays conductivity through a fixed internal resistance. Adjust the potentiometer POT R60 with a small screw driver until the display reads between 99.5 and 100.5.

   NOTE: The calibrate value will change if the integrator offset knob is moved form the fully counterclockwise position set in step 4. This is normal and does not indicate detector malfunction.

Appendix E

Quality Control Procedure

Note: The same equipment and lab environment must be used for this test.

EQUIPMENT

A. Series III HPLC pump
B. Injector with 20 µL sample loop
C. Injection syringe
D. Back-pressure regulator
E. ChromJet integrator

REAGENTS

A. Eluant: 1 mM sodium acetate in 95:5 methanol:water
B. Standard: 15 ppm sodium nitrate in eluant
C. Conductivity measurement: 1,000 µS/cm conductivity solution; prepare by diluting the 10,000 µS/cm solution 10 x with DI water

CONDUCTIVITY MEASUREMENT TEST

1. Connect the conductivity detector to the appropriate voltage (110 or 220V).
2. Turn the detector on.
3. Check the temperature reading on the front panel. The factory-set temperature is 35° C. If the display is not stable at 35° C (see operating manual to change the set temperature).
4. Set the detector into BACKGROUND mode. Pass water through the detector at a flow rate of 2 mL/min. After the reading stabilizes, reduce the flow rate to 0.5 mL/in. The injector can be bypassed.
5. Set the polarity to "+" and the time constant to "fast." Set the range to 500. Zero the reading on the display using the integrator offset knob located at the back of the detector (not the AUTOZERO key).
6. Pass 447.1 µS/cm conductivity solution at a flow rate of 2.0 mL/min. Once the reading stabilizes, reduce the flow rate to 0.5 mL/min. Record the lot number for the solution on the QC sheet. Wait a few minutes until the reading stabilizes. The meter should read 89.4 (89.4/100 x 500 = 447.1 µS/cm). If necessary, adjust the blue POT (1) until the display reads 89.4

ELECTRONIC TEST

1. Turn the integrator offset knob all the wan counterclockwise (facing the back of the instrument). Set the detector to CALIBRATE mode. It should automatically switch to range 100. The display should read 100 ±0.5. If the number is higher or lower, adjust the yellow POT (R60) to read 100.
2. Record this reading on the QC sheet.

PERFORMANCE TESTS

Start the pump with 1 mM sodium acetate in 95:5 methanol:water at a flow rate of 1.0 mL/min. Let the system equilibrate until baseline stabilizes. Adjust the back pressure regulator so the pump reads 250 psig.

A. Noise and drift test

1. Set the detector as follows:

Range:	5
Polarity:	Positive
Time constant:	Slow
Mode of operation:	Measure

2. Set the ChromJet Integrator as follows:

Attenuation:	0.5
Chart speed:	0.5
PT:	200
PW:	12
OF:	20

3. Press AUTOZERO on both the detector and integrator. Adjust offset of the detector if necessary.
4. Trace the baseline for one hour. Save the baseline trace for drift and noise evaluation.
5. Calculate drift. Beginning after 15 minutes of the one-hour run, measure the baseline drift for 15 minutes (7.5 cm). Report the drift in cm/min. Refer to Figure 1 as an example.
6. Calculate noise. Within the 15-minute section used for the drift measurement, pick 5 points randomly. Measure the short-term noise using the contact scale and report the average noise in mm.

B. Sensitivity test

1. Set the detector as follows:

Range:	5
Polarity:	Positive
Time constant:	Slow
Mode of operation:	Measure

2. Set the ChromJet Integrator as follows:

Attenuation:	0.5
Chart speed:	2
PT:	200
PW:	12
OF:	20
Baseline drawing:	Yes

3. Set the pump flow rate to 0.5 mL/min.
4. Press AUTOZERO on both the detector and integrator. Adjust the offset of the detector if necessary.
5. Inject 20 µL of the standard.
6. Repeat the injection 4 more times and record the peak areas.
7. Report the peak area as the average of the five injections.

NOTE: If the peak area is less than 80 000 (it may change later depending on the results of the first few detectors), adjustments to the sensitivity must be made. Adjustment procedures will be covered later.

SPECIFICATIONS

The detector must meet these specifications:

Sensitivity:	>80 000
Drift:	<0.1 cm/min.
Noise:	<3.0 mm

If the detector does not meet these specifications, it must be returned to the distributor.

INSTRUMENT QUALITY ASSURANCE TEST

Instrument: Model AL-350200 Conductivity Detector **Date:** _____

Serial Number: _____

Performance Test Method

Mobile phase:	1 mM sodium acetate in 95:5 methanol:water
Flow rate:	0.5 mL/min.
Range: 10 µS FS	
Polarity:	Positive
Time constant:	Slow
Mode of operation:	Measure
Sample:	15 ppm sodium nitrate in mobile phase
Injection volume:	20 µL

Actual	**Specification**
Peak area: _____	>90,000

Calibration Value

Electronic

Range:	100
Mode of operation:	Calibrate
Digital display reading:	_____

Conductivity Measurement

Temperature:	35° C
Range:	500
Mode of operation:	Background
KCI solution:	447.1 µS/cm (at 25° C)

Sensitivity Test Method

Mobile phase:	1 mM sodium acetate in 95:5 methanol:water
Flow rate:	1 mL/min.
Range:	10 µS FS
Polarity:	Positive
Time constant:	Slow
Mode of operation:	Measure
Data sys attenuation:	8 mV FS

Actual	**Specification**
Drift: _____ cm/min	<0.1 cm/min.
Noise: _____ cm/min	<5 mm

Polarity:	+
Time constant:	Fast

Polarity:	+
Time constant:	Fast
Lot #:	_____

Tested by: _____